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PNEUMATIC TIRE WITH INNER LINER OF VULCANIZED RUBBER COMPOUND CONTAINING LDPE OR LLDPE

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PNEUMATIC TIRE WITH INNER LINER OF VULCANIZED RUBBER COMPOUND CONTAINING LDPE OR LLDPE

[LDPE Matawa LLDPE o fukumu kokasareta gomu konpaundo no inna raina o yusuru kukiiri taiya]

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[There are no amendments to this patent.]

* * *

Claims /2

1. A pneumatic tire, characterized by the fact that in a pneumatic tire with an integrated inner liner of a sulfur-vulcanized rubber compound, said rubber compound is composed of (A) (1) a rubber at 60-100 parts by weight selected from a group comprising butyl rubber, chlorobutyl rubber, bromobutyl rubber, and their mixtures, and (2) a rubber at about 0-40 parts by weight selected from a group comprising acrylonitrile/butadiene copolymer, styrene/butadiene copolymer, natural rubber, and their mixtures, based on the total rubber content of the rubber compound being 100 parts by weight; and (B) a polymer at 5-15 parts by weight selected from a group comprising low-density polyethylene, linear low-density polyethylene, and their mixtures, based on the total rubber content of the rubber compound being 100 parts by weight.

2. The pneumatic tire of Claim 1, characterized by the fact that 0-30 parts by weight of the above-mentioned rubber are selected from a group comprising acrylonitrile/butadiene rubber, styrene/butadiene rubber, natural rubber, and their mixtures.

3. The pneumatic tire of Claim 1, characterized by the fact that the inner liner of the sulfur-vulcanized rubber compound has a thickness of 0.026-0.35 cm.

Detailed explanation of the invention

[0001]

Industrial application field

The present invention pertains to a tire with an integrated inner liner of a sulfur-vulcanized rubber compound.

[0002]

Prior art

The inner surface of a pneumatic tire is typically composed of an elastomer composition designed so that the permeation of air and water into a carcass from an air chamber in the tire may be prevented or delayed. It is often called an inner liner. The inner layer delays or prevents the escape of the air being used for expanding the tire and has been used for a long time to

maintain the tire pressure. Relatively air-impermeable rubbers such as butyl or halobutyl rubber are often used as the main part of the inner liner.

[0003]

The inner liner is usually manufactured by forming an unvulcanized mixed rubber strip with an appropriate width, often called a gum strip, by an ordinary calendering or milling technique. Typically, the gum strip is a tire element that is initially applied to a building drum (the remaining part of the tire is constructed on or around it) of the tire. When the tire is vulcanized, the inner liner is integrated and becomes part of the vulcanized tire. The inner liner of the tire and its manufacturing method are well known to the expert in this technical field.

[0004]

Problems to be solved by the invention

It is observed that the manufacture of the gum strip composed of only mixed chlorobutyl rubber or bromobutyl rubber has several working or manufacture problems, such as fixing to a working apparatus during the milling and calendering operations.

[0005]

Furthermore, it is desired to provide the gum strip for the inner liner with appropriate working characteristics in an unvulcanized state, sufficient green strength, building tackiness, vulcanized adhesion to a tire carcass, and sufficient air impermeability.

[0006]

The halobutyl rubber is the most expensive rubber used in the tire. In the competitive tire market, since it is necessary to continuously lower the manufacturing cost of the tire without sacrificing the characteristics, it is necessary to reduce or substantially reduce the cost of the inner liner that performs an important function in the performance of the tire.

[0007]

Means to solve the problems

The present invention pertains to an integral inner liner of a sulfur-cured rubber compound. This rubber compound is composed of (A) a rubber at 60-100 parts by weight selected from a group comprising butyl rubber, chlorobutyl rubber, bromobutyl rubber, and their mixtures and (B) a rubber at about 0-40 parts by weight selected from a group comprising acrylonitrile/butadiene copolymer, styrene/butadiene copolymer, natural rubber, and their mixtures based on the total rubber content of the rubber compound being 100 parts by weight.

This rubber compound also includes a polymer at 5-15 parts by weight selected from a group comprising low-density polyethylene, linear low-density polyethylene, and their mixtures based on the total rubber content of the rubber compound being 100 parts by weight (phr).

[0008]

The present invention pertains to a tire with an integrated inner liner of a sulfur-vulcanized rubber compound. The sulfur-vulcanized rubber compound includes 5-15 phr low-density polyethylene (also called LDPE in this specification), linear low-density polyethylene (also called LLDPE in this specification), or their mixtures. The use of the LDPE or LLDPE increases the green strength of the rubber compound and improves the handling characteristic and the workability of the rubber compound being used in manufacturing a raw tire. Unexpectedly, the addition of the LDPE or LLDPE increases the green strength without substantially reducing the mechanical or shielding characteristic of the vulcanized tire.

[0009]

The rubber component in the rubber compound being used as the inner liner can be changed in accordance with desired characteristics. For example, based on a total rubber content of 100 parts by weight, about 60-100 parts by weight is a "butyl type" rubber selected from a group comprising butyl rubber, chlorobutyl rubber, bromobutyl rubber, and their mixtures. Preferably, the amount of "butyl type" rubber is about 70-100 parts by weight. The preferred /3
"butyl type" rubber is a bromobutyl rubber. In addition to the butyl type rubber, the rubber compound can include a non-butyl type rubber being selected from a group comprising acrylonitrile/butadiene copolymer, styrene/butadiene copolymer, natural rubber, and their mixtures at about 0-40 parts by weight based on 100 parts by weight [total]. Preferably, the amount of non-butyl type rubber is about 0-30 parts by weight. The preferable use of the non-butyl type rubber will chang in accordance with the price, the characteristics, and the amount of rubber being used. The preferable non-butyl type rubber is an acrylonitrile/butadiene copolymer.

[0010]

Linear low-density polyethylene (LLDPE) is a low-density polyethylene characterized by few long-chain branches compared to ordinary low-density polyethylene. The method for manufacturing LLDPE is well known in this technical field, and commercial-grade polyolefin plastic can be obtained. In general, it is manufactured in a gas-phase fluid-bed reactor or a liquid-phase solution process reactor. The former method can be applied at a pressure of about 100-300 psi and a low temperature of about 100°C. Polymers are manufactured from a very narrow molecular weight distribution to a very broad molecular weight distribution at a melt index and a

density in an entire commercial range in a gas phase. The LLDPE is manufactured by copolymerizing ethylene and various α-olefins in the presence of an appropriate catalyst. Representative examples of the α-olefin are betene, hexene, and/or octane. The density of the LLDPE is determined by the properties of the linear low-density polyethylene resin polymerization, its manufacturing method, and the monomer control. The typical range of the density is about 0.914-0.932, though it is not regarded as an important factor in the present invention.

[0011]

It is considered that low-density polyethylene ("LDPE") is manufactured under a high-pressure condition and has a density of about 0.916-0.930 g/cm^3. The low density is generated from a region with many amorphous arrangements as the characteristic of the LPDE caused by its long chain branches that can include several thousand carbon atoms. The LDPE can be manufactured by a tubular reactor or stirring autoclave. A heated and pressurized ethylene gas supply flow, a peroxide-free radical initiator, and a chain transferer are injected into the reactor. The formation reaction usually occurs at 1500-3000 atm (152-304 MPa) and a temperature of 300°C or lower, as is well known in this technical field.

[0012]

The level of LLDPE, LDPE, or these mixtures existing in the sulfur-vulcanized rubber compound can be varied. For example, the level of LLDPE, LDPE, or these mixtures is generally about 5-15 phr. Preferably, the level of LLDPE or LDPE is about 10-15 phr.

[0013]

The rubber compound containing LLDPE, LDPE, or these mixtures can be mixed with ordinary rubber mixture components. For example, the components usually used in a vulcanized rubber product are carbon black, adhesive resin, working aid, talc, clay, mica, silica, antioxidant, ozone crack preventive, stearic acid, activator, wax, oil, and peptizer. As well known to the expert in this technical field, the above-mentioned additives are usually used in ordinary amounts in accordance with the intended uses of the sulfur-vulcanized rubber. A typical amount of carbon black is about 10-100 parts by weight (phr), preferably 50-70 phr based on the rubber at 100 parts by weight. A typical amount of talc, clay, mica, and silica can be in a range of about 10-100 phr. A typical amount of adhesive resin is about 2-10 phr. A typical amount of working aid is about 1-6 phr. A typical amount of antioxidant is about 1-10 phr. A typical amount of ozone crack preventive is about 1-10 phr. A typical amount of stearic acid is 0.5-2 phr. A typical amount of zinc oxide is 1-5 phr. A typical amount of wax is 1-5 phr. A typical amount of oil is 2-

30 phr. A typical amount of peptizer is 0.1-1 phr. A typical amount of magnesium oxide is about 0.1-0.5 phr. The existence of the above-mentioned additives and their relative amounts are not the aspect of the present invention.

[0014]

This compound for use as the inner liner is vulcanized in the presence of a sulfur vulcanizer. An example of an appropriate sulfur vulcanizer is elemental sulfur (free sulfur) or a sulfur-added vulcanizer. For example, amine disulfide, polymerized sulfide, or sulfur olefin adduct are included. Preferably, the sulfur vulcanizer is elemental sulfur. As well known to the expert in this technical field, the sulfur vulcanizer is used at an amount of about 0.2-8.0 phr, however a range of about 0.5-5.0 is preferred.

[0015]

An accelerator is used to control the time and/or the temperature required for the vulcanization and to improve the properties of the vulcanized product. A single accelerator group, that is, a primary accelerator, can be used at an ordinary amount of about 0.5-5.0 phr. A combination of two or more accelerators can also be used, and this combination is composed of a primary accelerator generally used at a larger amount (0.3-5.0 phr) and a secondary accelerator being generally used at a smaller amount (0.05-1.0 phr) to activate and improve the characteristics of a vulcanized product. It is known that the combination of these accelerators exhibit a synergistic effect in the final characteristics, and the combination of these accelerators is much better than the effect generated by the use of any single accelerator. Furthermore, a delayed-action accelerator which causes a satisfactory vulcanizing at an ordinary vulcanization temperature can also be used, though it is not influenced by an ordinary working temperature. Appropriate accelerators usable in the present invention are amines, disulfides, guanidines, thioureas, thiazoles, thiurams, sulfeneamides, dithiocarbamates, and xanthates. /4
Preferably, the primary accelerator is disulfide or sulfeneamide. If a secondary accelerator is used, the secondary accelerator is preferably guanidine, dithiocarbamate, or thiuram compound.

[0016]

In the application, the rubber compound is formed as a gum strip. As well known to the expert in this technical field, the gum strip is manufactured by passing the rubber compound through a press or mill, calender, multi-head extruder, or other appropriate means. Preferably, the gum strip is manufactured by the calender since the final product is more uniform. The unvulcanized gum strip is constituted as an inner surface (inner exposed surface) of the unvulcanized rubber tire or structure. The inner liner is sulfur-vulcanized with the remaining part

of the tire during the vulcanizing operation of the tire under heating and pressurizing conditions. The tire of the present invention is vulcanized at a temperature of generally about 100-200°C. Preferably, the vulcanization is carried out at a temperature of 110-180°C. An ordinary vulcanization method such as heating in a press or mold, heating in an overheated vapor or hot salt, or heating in a salt bath can be used. Preferably, the heating is achieved in the press or mold by a tire-curing method well known to the expert in the technical field.

[0017]

As a result of the vulcanization, the inner liner is vulcanized simultaneously with the tire, compared to a simple adhesive laminate, so that it becomes an integrated part of the tire. Typically, the inner liner of the present invention has an unvulcanized gum thickness of about 0.04-0.4 cm. Preferably, the inner liner has an unvulcanized gum thickness of about 0.08-0.2 cm. As the vulcanized inner liner, the inner liner can have a thickness of about 0.02-0.35 cm. Preferably, the thickness is about 0.04-0.15 cm.

[0018]

The pneumatic tire equipped with the integrated inner liner can be formed in automobile tire, truck tire, or other types of bias or radial pneumatic tires.

[0019]

The following application examples do not limit the present invention, but are shown for illustration. Parts and percentages are based on weight unless otherwise stated.

[0020]

Application Example 1

Two samples of sulfur-vulcanized rubber compounds were manufactured and tested. Table 1 shows the amount of bromobutyl rubber and LDPE. Two respective samples included the same level of an ordinary amount of carbon black, process oil, resin, stearic acid, zinc oxide, sulfur, accelerator, and magnesium oxide components. Sample 1 shows a comparison, and Sample 2 shows a pattern of the present invention.

[0021]

The material was mixed with all the components except for sulfur, accelerator, and ZnO and mixed at the second stage by the size BR Banbury (trademark) blender as a two-stage mixing process.